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THE DESIGN OF AIR COOLED CYLINDERS

GENERAL PATRICK ON THE INDEPENDENT AIR FORCE

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Real Leadership

BURIED in the several thousand pages of testimony taken before The Lampert Committee is a document that ought to be kept before everyone who has the future welfare of the Army Air Service at heart. It is the recommendation made by General Patrick to the War Department for the reorganization of the Air Service and it was given to the Committee by the Secretary of War. This short summary contains more sound thought and correct principles than any similar document that has come to the notice of AVIATION in the last ten years. It is printed in full elsewhere in this issue and should not only be read, but made the program of everyone who intends to make suggestions to Congress for constructive legislation for the Air Service during the next session.

Summarized, General Patrick's plan calls for the following changes:

Ultimately, a united air force.
Immediately, a separate corps.
A single supreme air commander.
Air Coast Defense concentrated.
Separate tactical training.
Separate Budget, and Estimates.
Suitable uniform.
Separate procurement policy.
Separate supply and distribution policy.

A careful reading of the presentation of the above suggestions will confirm the impression that the recommendations are as sound in their reasoning and as practical in their objectives as have been made by anyone during the controversy that has raged over the whole question of the future of national air defense. It took courage of the highest order for an officer with a distinguished Army career nearing the time of retirement to propose a line of action which would take all control of aviation away from the General Staff.

If some officer in the Navy would formulate a similar definite and independent plan for the reorganization of naval aviation and then some other well informed person with influence in official circles would prepare a policy for the encouragement of civil aviation by the government, perhaps those who have been discouraged since the war by the steady downward trend of government aeronautics would feel that the efforts that have been made by everyone who has not compromised sincere beliefs for official favor have not been fruitless.

It is most significant that an officer with the high connections of General Patrick should come out frankly and tell the General Staff that the Air Service would function better without its control. Since he has been in command of the Air Service, AVIATION has had occasion to differ often with some of the policies of the Chief of Air Service, but this statement is so completely in accord with the ideas that have been repeatedly expressed in these columns that we cannot but feel that if the same conclusions can be reached from an entirely different and much more restrained chain of reasoning, great hope can be entertained that Congress will take some action that will correct a situation that is holding back the development of our military aviation.

Acting Secretary of War Davis has stated that General Patrick's recommendation "is probably the best statement of the needs of the country from the standpoint of the Air Service that we have." At this time AVIATION wishes to go on record that it will support every one of the proposals made by the General and furthermore congratulates him on taking the leadership that will draw to it a host of followers. May we make a suggestion to those who believe that General Patrick has stated a sound and fundamental policy. Just write him a letter and give him the benefit of your suggestions and encouragement. Only by such encouragement can he be expected to lead the movement for a national military air policy.

The New Air Mail Head

WHILE the regret is general over the resignation of Col. Paul Henderson as head of the Air Mail, the choice of his successor indicates that there will be no change of policy in the conduct of the outstanding triumph of American Aviation. It is a unique example in governmental annals that what may be considered as a small part of the responsibilities of one of the numerous assistant secretarial positions should bring lasting fame and credit to the men who have with vision and courage seen the Air Mail through to its present world famous status. The names of Praeger and Henderson as well as that of Shaughnessy who was lost in the Knickerbocker Theatre disaster, will be indelibly written in deep and lasting letters on the tablets of the history of the progress of aviation. Often, it is overlooked that the Second Assistant Postmaster General has charge of all the transportation of mail—railway and steamship, as well as by airplane. The only difference is that the Air Mail is operated by the Post Office Department in the same way automobile trucks are directly under the control of the Postmaster General.

The new Air Mail head, the Honorable W. Irving Glover has been Third Assistant Postmaster General for four years. He has made a splendid record in handling the very complicated relations of publications with the Government as they have to do with postal rates. His new appointment by the President is an indication of the high regard in which he is held in official circles in Washington. Taking charge of the Air Mail at one of the most critical times in its history, his opportunity will be even greater than his predecessors. Every one connected with aeronautics will wish him success and hope that he may enter into the new field with the inheritance of good will and esteem that has always been one of the pleasant bequests of the office.

General Patrick on Independent Air Force

Separation from Army Now. Unification with Naval Aviation Ultimately

The Secretary of War gave to the Lampert Committee the recommendations of Maj Gen Mason M Patrick to the War Department for reorganization and development of the Air Service It appears on pp 632-635 of the second volume of the hearings. It embodies the opinion of the Chief of Air Service as the result of his three years' study of Army aviation. The conclusions should receive the endorsement of everyone interested in the future of military aviation. If you agree with the conclusions, write to General Patrick and give him your commendation.—Eb.

December 19, 1924

Subject. Reorganization of air forces for national defense.
To The Adjutant General.

It has been evident to me for some time thet the existing organization and method of administration of the Army Air Service present many complex problems, not a few of which are peculiar to this branch alone. In the general consideration of the major problems of the Army there are repeatedly found exceptions pertaining to the Air Service which place additional burdens upon the War Department as a whole, when possibly the Air Service alone should be held responsible for their solution. Several methods have been suggested to rectify the present difficulties, nona has yet met with general approval.

The Air Service is a growing factor in national defense; from day to day its rôles become increasingly important, many phases of our war plans must be constantly altered to keep pace. In any future emergency involving our military forces, particularly in the early phases thereof, the air force must be considered one of the vital factors.

The proper development of the Air Service and the determination of the rôle it shall play in national defense are matters which deserve, and should receive, the most careful consideration. **The Air Service must be so organized and maintained that it may he able to meet effectivaly the responsibilitim placed upon it.**

I am convinced that the ultimate solution of the air defense problem af this country is a united air force; that is, tha placing af all the component air units, and possibly all aeronautical development under one responsible and directing head. Until the time when such a radical reorganization can be effected certain preliminary steps may well be taken, all with the ultimate and in view.

The transition to the ultimate solution will require time and study and the passage of carefully prepared legislation. This step should not be taken hastily. However, there is an immediate need for certain remedial measures. **Legislation to place into effect the provisions of the Lassiter Board, approved in principle hy the Secretary of War over a year and a half ago, should be enacted at once and so broadened as to incorporate features for tbe development of tbe Air Service along tba lines indicated herein.** To place upon the Chief of Air Service additional functions which would relieva the War Department of certain of its responsibilities toward the Air Service is not without precedent, as evidenced by the Marine Corps, which is not a part of the Navy Department but is under the Secretary of the Navy. In fact, some such organization as this might be a very appropriate step to take at this time. As in the case of the Marine Corps, such a reorganization need not contemplate duplication of any activity which could be efficiently carried on by existing War Department agencies.

There are many details, in addition to those appearing in the succeeding paragraphs, relating to the present status of the Air Service and its administration under the War Department, which should receive consideration. The purpose of this paper is to show that an unsatisfactory condition exists and that, in order for the Air Service to develop and assume its proper place in national defense a depa ture from present methods must be inaugurated.

The commissioned personnel problem is most serious and perplexing. This service suffers nearly half of all the deaths annually in the Army—in 1921, 42 per cent, i 1922, 43 per cent, in 1923, 47 per cent, in 1924, 41 per cent—and yet the replacement of this personnel peculiarly adapted to Air Service requirements, must in general follow the same system as provided for the other branches of the Army. The principle of placing reserve officers on active doty in the Air Service for long periods of time has been recognized by the Lassiter Board and approved April 24, 1923, by the Secretary of War, yet the number so carried is negligible under War Department appropriations. The position of the great bulk of the junior officers of the Air Service on the promotion list a deplorable. Early in 1922 the Shanks Board appointed by the War Department reported in part: "The board is of the opinion that the situation will affect adversely the efficiency of the Air Service * * * The Air Service is the only branch or arm of the service which is adversely affected as a corps by the promotion situation." Several methods have been suggested by ma to rectify these difficulties under which the Air Service is at present laboring, and yet the status of my officers remains unchanged.

The flying personnel af the Air Service requires training very different from that af athers. Training policies of the War Department most carry exceptions or special regulations be provided for the Air Service.

The nonflying part of the enlisted personnel for the Air Service should be primarily mechanimans and technicians. They must be trained specialists. These enlisted men form practically no part of the actual fighting personnel of the Air Service, their work is principally the maintenance of the fighting machine. They are armed only with the pistol. Manifestly, the disciplinary instruction, drills, and combat maneuvers are not so essential to the preparation for their mission as in the other combatant branches. Many of the conditions surrounding their work are not found in the other combat arms. Accordingly, exceptions are made to many of the general policies of the War Department for the recruitment, training and employment of the enlisted man.

The great mobility of tha Air Service and the missioos it is capable of performing heve created a problem in command, tbe solution af which is still far from satisfactory. It is comparatively easy to place limitations—actual boundaries on tba ground—hatween a theatre af operations, a zone of communications, and a zone of the interior; but for the Air Service these all merge into one. Command becomes complicated, and somewhat overlapping, when air forces, based on airdromes in the zone of the interior carry our missions in the theatre of operations in connection with the ground troops or far beyand the hostile lines. The Lassiter Board has chosen to state that "this force should be organized into large units, insuring great mobility and independence of action." Future emergencies will require at the very outset, before the ground armies can get under way, and in many cases before the Navy can make its power effective, the maximum use of air power on strategic missions. Provision for the command of these air forces has not been satisfactorily made, nor is it known by me that there are even provisions for such initial air operations. **We should gather our air forces together under one air commander and strike at the strategic points of our enemy—cripple him even before the ground forces can come in contact. Air power is coordinate with land and sea pawer and the air commanders should ait in councils af war on an equal footing witb the commanders of the land and sea forces.**

Coast defense is a problem which it appears only a united air force can satisfactorily solve. The functions of the Army and Navy air forces overlap, and considerable confusion still exists as to the coordination thet is necessary and the functions each service would perform in order to secure an actual and practical defense. **As an immediate and practical step toward efficiency and economy, the Army Air Service should be definitely charged with all air operations conducted from shore stations. Ultimately all air forces in the aerial defeose af our coasts should be placed under one air commander and powers delegated to tbis commander that would permit the greatest latitude in the performance af his mission.**

A proper uniform for the Air Service has heretofore been recommended by me to the War Department. The high standard collar of the Army service uniform is wholly inappropriate for use by flying personnel. Medical officers have recommended against it and fliers themselves have repeatedly complained of its interference in the performance of their duties. The present uniform is also unsuited for work about mirers. The Chief of Air Service should be authorized to submit a design for a suitable uniform for his officers and men. Morale, as well as flying and working efficiency, would be greatly increased thereby.

Estimates from year to year for the Air Service are in accordance with the prescription of the War Department. Cuts in the budget have naturally been shared by the Air Service. In his first message to Congress the President said: "Additional planes are needed for the Army * * * * *." The National Advisory Committee for Aeronautics stated in its annual report last year: "Whatever may be the demands of economy serious consideration must be given to the increasing relative importance of aircraft in warfare, and funds appropriated to equip and maintain adequately the Air Service of the Army and Navy." In sending this report to Congress, the President laid particular emphasis on the importance of continued development of military and naval aviation. **I believe if the entire estimates for the Air Service were considered apart from those far the Army and the Chief of Air Service designated to defend them under a separate appropriation title, benefits would accrue to both the Army as a whole and the Air Service in particular.**

The Air Service is a supply branch and its work as such is almost entirely for its own service. Methods applicable to a supply branch like the Quartermaster Corps or the Ordnance Department, that supply several branches of the Army, are not always adaptable to the Air Service. Air Service procurement, storage and issue problems, and the policies regarding distribution and usage are matters that should be a responsibility of the Chief of Air Service, guided by very general policies established by the Secretary of War.

In furtherance of my conviction, as stated in paragraph 4, above, that additional responsibilities should be placed upon the Chief of Air Service, I recommend that immediate action be taken on the following:

Legislation should be prepared to make effective the provisions of the Lassiter Board for the expansion and development of the Air Service and this legislation should be submitted to Congress, accompanied by a special message from the President, setting forth its importance, in time for action to be had thereon not later than in the first session of the Sixty-ninth Congress. The recommendations of this board were approved in principle by the Secretary of War on April 24, 1923, and later in detail, after the joint board had given careful consideration and made only minor changes. (J. B. No 341 Sept. 11, 1923.)

Legislation should be prepared for the reorganization of the Air Service and as an air corps apart from the War Department. This legislation should be submitted to Congress, accompanied by a special message from the President setting forth its importance, in time for action to be had thereon not later than in the first session of the Sixty-ninth Congress. The work in preparation and submission of this legislation should not operate to delay action in making effective the recommendations contained in (a) above. Among the provisions that should be included in this reorganization are:

There should be in war plans one air commander, who, in at least the initial stages of an emergency, should control all operations of the air forces, both in the performance of distance strategic missions and in joint action with the land and sea forces.

The Army Air Service should be definitely charged with all air operations conducted from shore bases.

The Chief of Air Service should be responsible for the tactical training and efficiency of all Air Service units with a doctrine first of offensive action. This should include the means to secure and assure this efficiency.

The Chief of Air Service should be required to submit and defend legislation necessary to maintain a proper system for the procurement, assignment, promotion, elimination and retirement of his personnel. The sources for the procurement of commissioned personnel should include all those now employed by the War Department.

The Chief of Air Service should be authorized to submit the design of a uniform suitable for the requirements of his corps.

Estimates for the entire cost of the Air Service should be prepared by the Chief af Air Service under one appropriation title and defended hy him before Congress.

The Chief of Air Service, in addition to being responsible for the procurement, storage and issue of all items peculiar to the Air Service, should formulate the policies regarding their distribution and usage. He should also be responsible for transportation by air of personnel and supplies.

The time has arrived for constructive legislation which will provide for the expansion and development of the Air Service and I urgently recommend that action be immediately taken by the War Department to bring this matter to the attention of Congress.

Huff Daland Moving

Pennsylvania's first large, commercial airplane factory became a reality June 5, when title was closed and possession taken by Huff Daland & Co of part of the plant of the Merchants & Sterling Corp in Bristol. Huff Daland & Co is moving its plant down from Ogdensburg, N. Y., and actual work is expected to start in the Bristol plant within a few weeks.

The sale, which involved about $200,000, was carried through by Eastburn & Blauch, brokers, covers 30 acres and includes the present buildings and 2,000 ft. frontage on the Delaware River. During the war this was the site of the Merchants Shipbuilding Corporation, which acted as a Government agent. Seller was represented by J. A. Kissick, New York.

What this means to Pennsylvania and to Bristol was pointed out by Mr Thomas H. Huff, president of the company. Mr. Huff said:

"We are beginning now to recondition the plant here, where we shall employ several hundred men. P. H. Gray, our plant engineer, will have charge of this work, which will be quite extensive. We shall install a humidity heating control system, a thorough aerodynamical laboratory, lay out a flying field, and build a seaplane landing stage.

"None of the work now going on at Ogdensburg will be moved here. It will be finished there, and the new jobs will be started here. We shall build all types of planes, such as, training planes and bombers for our own and foreign Governments; non-stalling dusting, mail and express planes, for commercial purposes, and light sport planes of all types for both land and sea uses.

"The dusting planes are perhaps the most universally interesting at the moment, as they are an entirely new development in aviation. My company, which is the only concern building this new type, arrived at the present type after two years of co-operation and work with the Department of Agriculture down in Louisana. We are operating eighteen of these dusters in the South this year, on cotton, peaches and pecans, selling the service on contract to the planters.

The Design of Air-Cooled Cylinders

By C. FAYETTE TAYLOR

The cooling of the cylinder barrel below the combustion chamber is largely a problem of proper cooling fin design. The remarks on fin design which follow are applicable not only to the cylinder barrel, but to the combustion chamber walls and ports.

The arrangement of fins on an air-cooled cylinder depends primarily on the position of the cylinder with respect to the air blast. For aeronautical work, it is now universal practice to arrange the cylinder so that the air blast is directed against the side of the cylinder at approximately right angles to the cylinder axis. When this is the case, some type of circumferential finning is required. Circumferential finning has the following advantages as compared with finning parallel to the cylinder axis

(a) Adds greatly to the strength of the cylinder to withstand internal pressure
(b) Is easily machined where machining is necessary
(c) Is much easier to cast than the axial finning
(d) Gives more cooling surface on the ports and combustion chamber

The question of the proper size and spacing of the fins is one which has received a great deal of attention and has been the subject of a number of extensive research programs. The size and spacing of fins is largely controlled by the conductivity of the material used. However, for most materials, the scientifically correct finning calls for fins spaced so closely together and of such thin section that the manufacturing difficulties become prohibitive. Another consideration is that the fins must be sufficiently thick and strong to avoid damage in handling. The finning to be used, therefore, is the result of a compromise between these various factors. It has been found that for aluminum or cast iron cylinders, a very good design from all points of view is to make the fins 1 in. long with a thickness of 0.125 in. at the root and 0.0625 in. at the tip, with a spacing of 0.375 in. between fins. For steel, the fins may be half as thick and spaced as closely as 0.250 in. The fin spacing is usually increased where the finning intersects the valve ports, as otherwise the manufacturing problem becomes difficult. Fig. 1 shows, in general, the fin arrangement used on a number of recent successful air-cooled cylinders.

Considering the material of the cylinder from the point of view of cooling alone, we require:

1. A material having a high rate of heat transfer from its surface to air.

2. A material having rapid internal conductivity, so that the heat will flow readily from the hotter to the cooler parts of the cylinder, thus avoiding local overheating.

No definite data on the rate of heat transfer to air is available, but from experience it appears that aluminum, steel and cast iron possess this property to a high degree.

Aluminum

Of the metals having high heat conductivity, aluminum stands pre-eminent on account of its added advantage of light weight, although copper and its alloys have been proposed and used. The question of cylinder materials, however, is largely governed by considerations other than those of cooling and will be treated at greater length under the next heading.

As previously stated, durability is attained largely by the proper selection and distribution of materials, and by correct design and lubrication of bearing surfaces. Adequate cooling, which has already been discussed, also promotes durability.

The selection of materials for air-cooled cylinders, or for any piece of mechanism, is governed not only by the question of durability, but also by questions of weight and methods of manufacture. Special considerations, such as resistance to corrosion and appearance, may also affect the choice of materials. However, as durability is usually the primary factor, the selection of materials will be considered at length at this point.

In choosing the material for any particular part, it is first necessary to decide whether the part is primarily a structural or force-resisting member, a containing member, as for gases or liquids, a bearing member, or, as is usually the case, a member combining two or more of these functions.

Cylinder Stresses

Let us consider, for example, the cylinder body proper. This particular member combines all of the functions just mentioned. It is a structural member subject to high stresses due to gas pressure, forces at the hold-down flange, side thrust of the piston, and forces imposed by the operation of the valves and valve gear. It is a bearing member where the piston and piston rings slide in the bore, and it is a containing member for the gases of combustion and for lubricating oil. Furthermore, it is a part of complicated shape, which must be made by casting, unless its manufacturing cost is to be excessive. Cast iron will fulfill all of the functions in a fairly satisfactory manner, but its weight is generally prohibitive, at least for military engines. For commercial engines cast iron cylinders may often be used to advantage. Cast aluminum alloy is satisfactory as a containing member and can be cast in intricate shapes. It will also stand a fair degree of stressing, and it is a fairly good bearing material. However, where high localized stresses are encountered, cast aluminum alloys are liable to failure by fatigue, and consequently have been found unsatisfactory for the hold-down flange, where the cylinder is bolted to the crankcase unless very heavy sections are used. Although aluminum is a good bearing material under certain conditions, it is not entirely satisfactory for the bearing surface of the piston. This is largely because the piston itself must be of aluminum and two materials of the same kind do not usually form a first-class bearing surface. Furthermore, carbon particles from the combustion chamber will score the comparatively soft aluminum of the cylinder walls. A few engines have been built where the piston and piston rings run in an aluminum cylinder bore, and in three it has been found that after long periods of running the bore shows rather deep scores and scratches. Where long life and extreme durability are desired, therefore, we must conclude that the aluminum alloy at present available is not a satisfactory material.

In order to overcome these difficulties, a combination of materials has usually been resorted to. Steel makes an excellent bearing surface for the piston, and is also the best material available for resisting fatigue and localized stresses such as are encountered at the hold-down flange of the cylinder. It is now almost universal practice in aeronautical work to make air-cooled cylinders with an aluminum alloy head and a steel barrel with hold-down flange. The cooling fins on the barrel may either be machined integral with the steel as shown in Fig. 1, or may be cast with the aluminum head as shown in Fig. 2, the steel barrel being made a very tight fit in the aluminum. Various methods of attaching the steel barrel to the aluminum head have been tried. The most satisfactory appears to be to provide the upper end of the barrel with a suitable screw thread which fits into corresponding threads in the cylinder head as shown in Fig. 1 and 2. It is necessary to make the diameter of the threads in the aluminum head slightly smaller than the diameter of the threaded portion of the barrel, and the operation of screwing in the barrel is done with the head heated to a high temperature, thus securing what is known as a "shrink fit."

Another alternative for the material of the cylinder body is to make it entirely of steel, as was done in the case of the rotating cylinder, or "rotary" engines, which were popular a few years ago. Steel is a satisfactory material from the point of view of weight, since its strength makes possible the use of very light sections. It is also one of the best structural materials. It is satisfactory as a containing member and appears to be satisfactory from the point of view of cooling. The greatest objection to the all-steel cylinder is the expense of manufacture. It has not been found practicable to cast steel in the thin sections necessary for an air-cooled cylinder, and it is therefore necessary to machine the cylinder from a forging, an extremely long, difficult and expensive process. On this account the all-steel cylinder has been practically abandoned for aeronautical use.

Valve Ports

The valve ports are primarily gas containing members, although they are subject to some stresses imposed by the manifolds and valve gear. When the cylinder is made from a casting it is best to form the ports as integral parts of the casting, and aluminum is quite satisfactory from this point of view.

The choice of material for the intake valve is comparatively easy. It is a gas containing member subject to fairly high stresses and shock loading, with a bearing surface along the stem. An ordinary high-grade alloy steel will be satisfactory for this purpose, provided the valve stem can be well lubricated. Where the valve stem cannot be lubricated, as in the case of an "open" valve gear, it may be necessary to make the intake valve from an extremely hard material, such as case hardened or a tungsten alloy steel.

The conditions of operation of the exhaust valve are like those of the intake valve, except that the exhaust valve must operate at extremely high temperatures. For this part it is necessary to use a material which has a high strength at high temperature, and is not affected by a corrosive action of hot exhaust gases. Special steels containing tungsten, chromium or silicon as the principal alloying elements are necessary for this part. For a more complete discussion of this subject the reader is referred to S. D. Heron's article in the *S.A.E. Journal* for August, 1924.

The valve guides are essentially bearing members, and the material to be selected depends largely on the amount of lubrication which can be provided for the bearing surface. For the "open" type of valve gear where there is little or no lubrication, the guides should be made of extremely hard material, such as case hardened or tungsten steel. The latter is particularly useful for the exhaust valve guide, as it will retain a large measure of its hardness at high temperature. Where the valve guide is well lubricated, as with an enclosed and positively oiled valve gear, the softer bearing materials, such as bronze or cast iron, may be used on the intake valve guide, but it is often desirable to use hard materials for the exhaust guides on account of the high temperature at which the lower end of the guide is forced to operate. The subject of valve guides is covered exhaustively in the article by S. D. Heron previously mentioned.

Alloys

The consideration in detail of the various alloys of steel, aluminum and copper (bronzes) available for the construction of aircraft cylinders is not within the scope of this article. It is well to remember, however, that the rapid progress in the development of aeronautical engines has been due in no small degree to the wonderful progress in the sciences of metallurgy and metallography which has taken place in the last few years. This is especially true in the field of aluminum alloys, which have been developed to a point where their physical properties are not far behind those of ordinary low carbon steel. Table 2 shows the principal characteristics of a number of the more important aluminum alloys used in the construction of aeronautical engines.

The distribution of materials enters into every phase of design, but will be treated here from the point of view of securing satisfactory durability. In designing any part, it is necessary to analyze the nature and extent of the deteriorating forces present. These may be classified roughly as direct stresses, vibrational stresses, stresses imposed in handling, wear by friction, and corrosion.

Of all the deteriorating forces mentioned, the direct stresses are the only ones which can be analyzed quantitatively with any great degree of accuracy. Calculations of direct stresses are very valuable when their limitations are definitely kept in mind. In the case of the cylinder, it is possible to calculate fairly closely the stresses caused by the pressure of the gases against the cylinder walls and cylinder head, and the resultant stresses imposed on the flange where the cylinder is bolted to the crankcase. Other simple forces, such as the side thrust of the piston against the cylinder wall and the stress in the joint between the cylinder sleeve and cylinder head, can also be calculated with a fair degree of precision. From these calculations it is possible to determine the amount of material to be used at these points, always making allowance for other stresses which cannot be calculated, such as those due to vibration and handling. In order to take care of these unknown stresses, it is customary to introduce what is known as a "factor of safety." After determining the necessary thickness of material to withstand the direct stresses, this result is multiplied by the factor of safety in order to establish an ample margin to cover the unknown stresses.

Factor of Safety

The question of factors of safety is intimately related to the question of fatigue of materials. It is known that metal parts subject to vibration or to frequently repeated loads or shocks may eventually fail, even though the stresses imposed by those loads are much smaller than the maximum stresses which the material will stand under a stationary or gradually applied load. A large number of experimental investigations have been made to determine the so-called "fatigue limit" for various materials. The fatigue limit is defined as the maximum stress which a given material will stand indefinitely under conditions where the load is rapidly applied and removed or the direction of loading rapidly reversed, as in the case of parts subject to severe vibration or to alternating stresses. Naturally, the fatigue limit is considerably lower than the ultimate strength of a material, and therefore the factor of safety must be increased where the material is subject to this type of loading. Almost all of the parts of a cylinder are subjected to vibration, and most of them to rapidly changing loads. None of the material used in the construction of the cylinder should, therefore, be stressed in excess of its fatigue limit. The subject of fatigue of materials cannot be treated at length in this article, but is one which the reader could well study more extensively. Numerous publications on this subject have been issued in recent years.

The temperature at which the various parts will operate is an especially important consideration in air-cooled cylinder design, since the temperatures encountered in this particular field are much higher than is usual for ordinary machine parts. The strength of metals decreases rapidly with increasing temperature, and it is therefore necessary to allow larger sections for those parts, such as the exhaust valve, exhaust port walls, and cylinder head, where the temperatures of operation are high. Factors of safety should be based on the characteristics of the material at its operating temperature, wherever the necessary data are available. Table 3 gives recommended values for the factor of safety for those parts of the cylinder, the direct stresses in which can be readily calculated.

Another consideration in determining thickness of sections and distribution of material is the amount of deflection allowable. On most engine parts, including the cylinder, very little deflection is permissible and parts must be designed with this consideration in view.

Regarding the wearing surfaces, where ample lubrication can be provided, it is best to form the bearing of two different metals, one hard, such as steel, and one soft, such as bronze or aluminum. Where little or no lubrication is possible, both members of the bearings should be made as hard as possible, so as to reduce the wear to a minimum. This has already been mentioned in the case of valve stems and valve guides. The larger the bearing surface, the lower will be the unit pressure and the greater will be the durability of the bearing. In

cylinder design, however, the available bearing areas are usually limited by space restrictions. It has been found best to allow for a total bearing length on the piston of at least two-thirds its diameter. Valve guides are subject to much higher unit pressures and, if possible, their length should be at least five times their diameter, and the diameter should be as great as possible without unduly restricting the valve ports by large valve stems. For the exhaust valves, a stem diameter of one-quarter to one-third the valve diameter has been found necessary, while for intake valves the stem may be made somewhat smaller

Handling

The question of allowance for handling of the parts comes up particularly in the case of the cooling fins, which can be easily broken if the cylinder is not carefully handled. It has been found that the fin dimensions suggested earlier in this article are sufficient to withstand reasonable handling, but that if the fins are made much thinner, they will frequently be broken when subjected to ordinary shop handling. Other parts where handling must be considered are those with threads, such as bolts and studs, where the stresses imposed in assembling may be higher than the stresses caused by engine operation. It has been found by experience that for important fastenings, screw threads less than 0.25 in. diameter should never be used, and a minimum of 0.3125 in. is better in order to avoid stripping of the threads by careless mechanics.

Parts subject to the corrosive action of hot exhaust bases must be made with larger sections than if this action were not present, since corrosion of this kind gradually reduces the amount of metal available to fulfill the other functions of the part. This is particularly true of the exhaust valve, exhaust port and cylinder head. The best method of meeting this problem is to choose materials which have the maximum possible resistance to corrosion. For exhaust valves, steels containing silicon and chromium as the principal alloying elements have been found very satisfactory in this respect, and the aluminum alloys shown in table 2 have also proved themselves to be reasonably free from action of this nature.

The problem of distribution of materials cannot be reduced to hard and fast rules which will give the necessary thickness of material for any part. The actual size and arrangement of any part are, after all, dictated largely by experience, which must be obtained by familiarity with engines under actual operating conditions and study of previous successful designs. Without this experience the best designers could not hope to produce a successful cylinder.

Lubrication

The lubrication of the various parts of an air-cooled cylinder is a somewhat difficult problem and depends to a large extent on the arrangement of the engine on which the cylinder is mounted and the position of the cylinder on that engine. The principal bearing surfaces to be oiled is, of course, the cylinder bore. This is usually lubricated by oil sprayed from the crankpins and connecting rods, and is primarily a question to be considered in the design of these parts and the piston. The other parts on the cylinder which require lubrication are the valve guides. Until recently the only lubrication ordinarily furnished these parts has been that obtained from the fuel mixture on the intake side and from what little oil is carried through with the products of combustion on the exhaust side. The amount of lubrication thus obtained is so small that for all practical purposes the valve guides and valve stems are without lubrication. In recent designs, however, and particularly in "In-Line" and "V" type engines, the valve gear has been enclosed and run in a bath of oil. Some of this oil finds its way into the valve guides and by this means the durability of valve stems and guides is greatly increased. As the oil supply to these parts is almost entirely a question of valve gear design, it will not be considered further in this article.

The weight of the parts which go to make up an aircraft engine must be completely kept in mind by the designer. Every pound which is put into the engine means a sacrifice of an equivalent weight which would otherwise be available for useful load. The low weight in proportion to the power output which is possible in internal combustion engines is largely responsible for the present state of aeronautical development. The introduction of alloys of aluminum has assisted greatly in weight reduction, although the increase in the quality and tensile strength of alloy steels has been of almost equal assistance. Table 4 shows the weight per unit of volume and the tensile strength of some of the common alloys used in air-cooled cylinder construction.

While the choice of material is important in obtaining the minimum weight, the elimination of unnecessary material is equally important, and the design should therefore be studied in every detail to be sure that no material is introduced which does not perform a very definite function. The thickness of all sections should be held to the minimum consistent with strength and durability. Here again past experience is of great importance in determining how far one can go in reducing the sections of the various parts before their durability is affected.

Magnesium

Recently, alloys containing a large percentage of magnesium have been proposed for use in aeronautical engines. While these materials are still in the experimental stage and cannot be considered entirely satisfactory except for unimportant parts not subject to high stresses or to heat, the writer believes that alloys of this class will eventually be used and will effect a further reduction in the weight of aviation engines. An alloy of this nature has been included in tables 2 and 4 for comparison with steel and aluminum alloys now commonly used.

By careful design it is possible to avoid excessive manufacturing costs without sacrificing any of the desirable characteristics already emphasized. In general, it may be said that all machine work is expensive, and that parts should be formed as much as possible by casting, forging or stamping, if production costs are to be kept to a minimum. On the other hand, these operations are in many cases impossible or so inaccurate that allowance for variation must be made by increasing the sections of the parts, with consequent increase in weight. Since this is not usually permissible in aeronautical work, most parts must be subjected to a great deal of machining. This being the case, the machine work should be confined as much as possible to the cheaper operations. Expensive operations, such as profiling, end milling, and drilling holes where the length is very great in proportion to the depth, should be avoided. Here again the designer must depend on his experience and knowledge of shop methods, and must co-operate closely with those who will have charge of the manufacture of the parts.

Conclusions

The field of air-cooled cylinder development is still in its infancy, and it is dangerous to make definite predictions for its future. If an opinion may be ventured, it would be to the effect that the basic principles set forth have been definitely established, and that future progress will be confined to detail refinements as long as the orthodox four stroke cycle is retained. The greatest fields for detail improvement appear to lie in reducing weight by the use of materials having a higher strength weight ratio, in improving durability, especially in the case of the exhaust valve and valve guides, and in the simplification of design to reduce the cost of production.

TABLE I

Average power per cubic inch piston displacement for air-cooled aviation engine cylinders, 5.2 compression ratio.

R.p.m.	Brake mean effective pressure lb./sq.in.	Brake horsepower per cubic inch of piston displacement
1,600	120	0.248
1,700	122	0.281
1,800	121	0.275
1,900	125	0.287
2,000	120	0.300
2,100	117	0.313
2,200	115	0.310

TABLE 2

Properties of Aluminum Alloys Used for Aircraft Engine Construction

Name of alloy	Approximate Chemical Composition %	Heat Treatment	Average Physical Properties: Tensile Strength lb./sq.in.	Elongation %	Brinell Hardness No.	Remarks
8% Copper Alloy N.A.C. RR404	Copper 8.0 Impurities 1.7 max. Aluminum remainder	Annual	14,000 to 18,000	3.0	55 to 60	Used for general casting purposes.
Silicon Alloy (Developed by U. S. Air Service)	Copper 2.0 Silicon 4.5 Impurities 2.5 max. Aluminum remainder	Annual	20,000 to 23,000	9.0 to 9.0	60 to 65	Easy to cast and free from casting defects. Does not machine freely.
Lynite No. 195 N.A.C. NF-130	Copper 5.0 Manganese 0.1 Silicon 0.65 Impurities 1.0 max. Aluminum remainder	96 hr. at 570 deg. F. Quench cold water	25,000 to 35,000	6.0	50 to 60	Used for highly stressed parts not subject to heat.
Duralumin (Forged)	Copper 4.5 Manganese 0.7 Magnesium 0.6 Impurities 1.5 max. Aluminum remainder	Varies with manufacturer	55,000 to 60,000	17.0	100	For parts subject to high stresses and shock loading which can be made by forging or rolling.
"Magnalite" or "Y" Alloy N.A.C. NF 133	Copper 4.0 Magnesium 1.0 Nickel 2.20 Impurities 2.0 max. Aluminum remainder	8 hr. at 958 deg. F. Quench boiling water. Age 10 hr. at 400 deg. F.	33,000 to 40,000	3.0 to 6.0	90 to 110	A high strength cast and heat treated alloy. Used for cylinders pistons, etc.
Al Cu F. Mg Lualle No. 122	Copper 10.0 Iron 1.25 Magnesium 0.30 Impurities 1.0 max. Aluminum remainder	6 hr. at 920 deg. F. Quench boiling water. Age 15 hr. at 300 deg. F.	30,000 to 40,000	1.0	90 to 110	Used principally for pistons.
Magnesium Alloy	Magnesium 88% Aluminum 9% Zinc 1%	None	19,000	6.3	45	Experimental.

TABLE 3

Factors of Safety

Part	Material	Direct stresses	Other Considerations	Recommended Factor of Safety based on ultimate Strength at room Temperature
Cylinder barrel at thickest section	Steel	Tension due to pressure on cylinder head	Rapidly varying load Vibration Fairly high temperature	8
Head down studs (1/8 diameter)	Steel	Tension due to pressure on cylinder head	Rapidly varying load Severe handling stresses	12
Side of combustion chamber at thinnest section	Aluminum Alloy	Tension due to pressure on cylinder head	Rapidly varying load High temperature	10

TABLE 4

Table Showing Strength Weight Ratio of Various Materials

Material	Weight lb./cu.in.	Ultimate strength lb./sq.in.	Strength / Weight ×1000
Steel	0.282	60,000	213
Steel, heat treated	0.282	175,000	620
Duralumin forged and heat treated	0.101	60,000	594
Cast aluminum, 8% copper	0.11	16,000	145
Cast aluminum high strength, heat treated alloys	0.11	99,000	919
Magnesium alloy— 90% magnesium, 9% aluminum, 1% zinc	0.064	18,000	280

Plans Maturing for Intercity Airplane Tour

Arrangements to go forward with the promotion of an intercity airplane reliability tour this summer were completed at a meeting of the Detroit Aviation Society on May 28 and William B. Mayo, president of the society, sent a request to Ceker F. Clarkson, general manager of the Society of Automotive Engineers, to attend a meeting in Detroit the first week in June to cooperate in the preparation of detailed plans for the arrangements to be made for the conduct of the event which will be the first of its kind.

Before leaving for the West, Mr. Clarkson issued a call for a meeting of the Aeronautical Advisory Committee of the Society of Automotive Engineers to consider the draft of rules for the contest as prepared by the Contest Committee of the National Aeronautic Association.

The tour, as proposed and discussed at previous meetings by officers of the Detroit Aviation Society with representatives of the Society of Automotive Engineers and as endorsed recently by the Board of Governors of the National Aeronautic Association, is to start at Ford Airport, Dearborn, Mich., on Labor Day, Sept. 7, and continue for one week, with a one-day stop in each of half a dozen Middle Western cities where there are good landing fields and other necessary facilities, as at Fort Wayne, Chicago, St. Louis, Indianapolis, Dayton, Columbus (Ohio) and Cleveland, and finish at the starting point.

Members of the S.A.E. Aeronautic Advisory Committee called together to consider the draft of rules for the contest are:

Paul G. Zimmerman, Keyport, N. J., chairman; Henry M. Crane, General Motors Corp., New York City; F. G. Ericson, Ericson Aircraft, Ltd., Toronto, Can.; R. Depew, Fairchild Aerial Camera Co., New York City; W. L. Gilmore, Curtiss Aeroplane & Motor Co., Buffalo, N. Y.; T. H. Huff, Huff Daland Aero Corp., Ogdensburg, N. Y.; G. J. Mead, Wright Aeronautical Corp., Paterson, N. J.; A. P. Loening, Loening Aero. Eng. Corp., N.Y.C.; R. W. Schroeder, Aircraft Development Corp., Detroit; W. B. Stout, Stout Metal Airplane Co., Detroit; R. H. Upson, Aircraft Development Corp., Detroit; L. M. Woolson, Packard Motor Car Co., Detroit; C. M. Vought, Chance Vought Corp., Long Island City, N. Y.; E. P. Warner, Massachusetts Institute of Technology, Cambridge, Mass.; L. C. Milburn, Glenn L. Martin Co., Cleveland; A. V. Verville, Buhl-Verville Co., Detroit; E. A. Johnson, Johnson Airplane Supply Co., Dayton, Ohio.

Some Problems on the Lift and Rolling Moment of Airplane Wings

N.A.C.A. Report No. 200

This paper is part of the thesis submitted by James B. Scarborough to Johns Hopkins University for the degree of doctor of philosophy.

This report deals for the most part with the application of the airfoil and twisted wing theory to the calculation of the lift and rolling moment of airplane wings. Most of the results arrived at are strictly true only for wings of elliptic plan form. The investigation aims to give some indications of the accuracy with which the results can be applied to the wing forms in actual use.

National Guard Cross Country Meet

By MAJ. W. D. TIPTON

Commanding Officer 29th Division Air Service, Md. N. G.

A very interesting contest, unique in the history of aeronautical events, was staged Saturday, May 30, at Logan Field by the 29th Division Air Service of the Maryland National Guard. The competition was known as the Sealed Orders Flight for a prize of $1000 offered by the *Baltimore American*.

The contest took the form of a scheduled cross country flight from Baltimore across the Chesapeake Bay to the eastern shore cities of Easton, Denton, Salisbury, Chestertown, and Centreville, stops being made in order named and return across the Bay to Logan Field. The entire flight was scheduled at the rate of one mile a minute. Each contestant was required to land on scheduled time, take off on scheduled time, and was required to land five minutes after being sighted at each field, or otherwise suffered a penalty. Penalties were charged against the contestants whether they were early or late in either landing or taking off.

Controls

Contestants, leaving Logan Field, were each handed an order giving the time of departure from Logan Field and the time of arrival at the next stop, Easton, Md., when the contestants arrived at Easton, they were given further orders to fly on scheduled time to the next stop and so on. Observers were stationed at all six fields with orders to check to a fraction of a minute the time each contestant was sighted, the time he landed and the time he took off. Upon landing at each of the different control fields, the contestant was allowed 10 minutes to get his new orders, figure out his course and get off. At Salisbury, the mid-point in the course, 45 min. were allowed to refuel. The penalties took the form of minutes in variation from the schedule whether late or early.

The idea behind the flight was two-fold, first to demonstrate the degree of training and efficiency in cross country flying attained by officers of the local National Guard unit, and second, to demonstrate that Chesapeake Bay, while a natural barrier to surface transportation, was eliminated by the airplane and that airplanes could maintain a schedule over the entire eastern shore without difficulty. Eight planes of the National Guard Unit were used and the eight teams competing were made up of an officer and an enlisted man.

Prizes offered by the *Baltimore American* were:
First $350 for officer, $150 for enlisted man.
Second $250 for officer, $100 for enlisted man.
Third $100 for officer, $50 for enlisted man.

The contest started at 9 o'clock, with Capt. Chas. A. Masson leaving, followed at 15 min. intervals by Lieut. W. O. Snyder, Lieut. Thos. B. Bourne, Lieut. Robt. J. Stewart, Lieut. Harold R. Bohlman, Lieut. James C. Hooper, Lieut. Leo M. Willinger and Lieut. Otto Melamet. The day was very poor for flying but excellent for this contest. Immediately upon leaving Logan Field all pilots were lost in a thick fog which covered the Bay and had to make the first leg to Easton by compass alone. Throughout the entire flight weather conditions were much the same, improving somewhat during the day.

Winner

The winner of the contest was Lieut. Harold R. Bohlman, who made the entire course with the remarkably small variation from scheduled time of 1.25 min. Second place was won by Lieut. W. O. Snyder, whose error was only 2.75 min. greater than the winner and third place by Lieut. James C. Hooper who was 10.25 min. off schedule time. Lieut. Robt. J. Stewart and Capt. Chas. A. Masson were fourth and fifth. Three planes were eliminated. Lieutenant Bourne tipped over in a ditch after a fast landing at Easton and cracked his propeller. Lieutenant Melamet after blowing out both of his tires at Easton, landing at Denton on bare rims, came to grief in the rather soft field at Salisbury and turned over on his back. Lieutenant Willinger suffered the only mechanical trouble of the day, a clogged gasoline strainer, near Salisbury. All ships returned to Logan Field on Sunday morning by air, after minor repairs had been effected.

All pilots will appreciate how difficult it is to land exactly on the minute. The times of landing and take off in this contest were taken for landings when the wheels touched the ground and for take offs when the throttle was open. For the purpose of showing how very closely Lieutenants Bohlman and Snyder adhered to the schedule, it is herewith set down in detail:

	Lieut. Harold R. Bohlman	Landed	Took off
	Scheduled Time	10 43	10 [illegible]
Easton	Actual Time	10 43	10 [illegible]
	Scheduled Time	11 00	11 [illegible]
Denton	Actual Time	11 00	11 10
	Scheduled Time	11 50	12 44
Salisbury	Actual Time	11 50	12 41
	Scheduled Time	1 48	1 [illegible]
Chestertown	Actual Time	1 48	1 [illegible]
	Scheduled Time	2 11	2 [illegible]
Centreville	Actual Time	2 12¼	2 [illegible]
	Scheduled Time	2 50	
Logan	Actual Time	2 51	

Lieutenant Snyder varied but slightly with Lieutenant Bohlman. He made an error in taking off of one-half minute because one of his watches was not exactly synchronized with those of the timers, and he made no other variation from the schedule greater than a minute.

Conclusions

Many interesting points are brought up from this contest. First, the two who made the best score made very careful preparations for the race. Although they had no idea what the course would be, they did know the cities to be visited and they had every possible course plotted on the map. Further, each pilot had carefully swung his compass and had a chart of deviations. Two pilots were lost in the first leg from Logan to Easton. The answer is very simple. Although they had compasses in the back seat of the dual control ship, they elected to fly from the front seat where they could not read the compass. Another pilot who came to grief during the race had failed to check his gasoline strainers and gasoline lines. But three pilots made careful preparations for the contest and of those three, two of them came in the money, the third was eliminated by an accident.

In scheduling the course at 60 m./hr. for ships which could cruise 80, an effort was made to eliminate everything but the human elements, in other words, every ship could easily make the course in time if the pilot flew his course properly. The whole contest ran very smoothly. Landing fields had been selected over the shore and had been photographed in relation to the city itself. Representatives of the *Baltimore American* with synchronized watches were at each field early Saturday morning and laid out a "T" shaped marker.

At the Salisbury field a plentiful supply of gasoline was available. Excepting one forced landing due to stoppage in gasoline line, every pilot's performance, good, bad, or indifferent, could be charged to the pilot himself and it is suggested that contests of this nature are a most excellent means of checking cross country ability of pilots, particularly when all preparations for flying the course are left to the initiative of the pilot himself.

It is believed that such a contest wherein all of the National Guard Units on the Atlantic Seaboard, Maryland, Pennsylvania, New York, Massachusetts and Connecticut, would participate, would be most interesting and instructive.

W. I. Glover to be new Air Mail Chief

President Coolidge has announced the appointment of Honorable W. Irving Glover, Third Assistant Postmaster General, Post Office Department, to be Second Assistant Postmaster General to take effect August 1, 1925.

As the second Assistant Postmaster General has charge of all transportation of the mails, the Air Mail comes under his direction. The reason for this change is because of the resignation of Col. Paul Henderson to become General Manager of the National Air Transport which has recently been organized.

Mr. Glover was born in Brooklyn, N. Y., on Oct. 2, 1879. He was educated in the New York public schools, attending "Old 15," graduating there, as well as in the High School. When eighteen years of age he entered the woolen industry and was employed in the Old Commission House of James Talcott for a period of years and while there took a technical course in spinning and weaving at the Phoenix Woolen Company, Stafford, Conn., later becoming New York Sales Representative of the Company.

Early Business

In 1906 organized the Afton Holding Corporation and, in 1908, the Sussex Holding Corporation, both Corporations being engaged in building construction in New York City and vicinity. Mr. Glover is connected with the Sussex Holding Company as its Treasurer and the offices of the Company are located at No. 299 Madison Avenue, New York City.

Mr. Glover entered politics early in his and his first active campaign was in behalf of Theodore Roosevelt when he ran for Governor. For years Mr. Glover was a member of the Third Ward Republican Club. In 1908, he took up his residence in Englewood, N. J., where he has since made his home. It was not long after coming to New Jersey that he took an active interest in politics and was soon elected to the Bergen County Board of Freeholders when that Board was elected by Districts and he was elected from his home city of Englewood at the Countyseat. In 1917 he was elected to the New Jersey Assembly and served for five terms, which up to that time, and even now, is the longest term ever served by an assemblyman from Bergen County.

In 1920, Mr. Glover was the unanimous choice of the House for Speaker and served with credit and distinction both his county and state. It was during his term of office as Speaker that the House of Assembly passed the 19th Amendment after a most bitter fight and contest on the Floor. The House was divided, not as political parties, but Republicans and Democrats took sides for and against the passing of the Amendment. The Speaker was for the passing of the ratifying resolution and, after a 5½ hour debate, the resolution was passed. It was said that more parliamentary questions were propounded to the Speaker that night than had ever been known before to have been put to a Speaker in New Jersey, and that memorable struggle is still talked of in the Capital City.

Harding's Friend

In 1920, after the close of the Presidential campaign, in which he had taken a most active part in his home State, Mr. Glover went to Central America and the Panama Canal, and returned on the same ship which brought home to the United States the then Senator Harding, and an acquaintanceship was made with President Harding which continued until the President died.

In May, 1921, Mr. Glover was selected as the third assistant postmaster general by the Hon. Will H. Hays and has served under three postmasters general—Hon. Will Hays, Dr. Hubert Work and Postmaster General Harry S. New, and was selected by Doctor Work as a Member of the United States-Canadian Postal Conference Committee which met in Ottawa, Canada, in 1922, and was later selected by the late President Harding and Postmaster General New to represent the United States Government at the International Philatelic Congress which was held at Royal Horticultural Hall, London, England, in May 1923. Mr. Glover was also chosen by Postmaster General New to represent the United States Post Office Department as Head of the Postal Commission which visited Cuba in January, 1925, and served as Chairman of said Committee.

W. Irving Glover

Mr. Glover has served as Third Assistant Postmaster General for four years and during this period he has attended State Postal Conventions in every state in the Union, and, in so doing has formed a wide acquaintanceship with the personnel of the Postal Service. He has greatly improved the morale of the service through the medium of personal contact and the vast amount of correspondence which he has received as a result of his attendance at these conventions proves beyond a doubt that they have been of inestimable value to the Department and the Postal Service as well.

During Mr. Glover's incumbency as Third Assistant Postmaster General he has brought about many improvements in the service in his Bureau. Among the most noteworthy improvements that he has inaugurated since his appointment are the following:

In December, 1921, he established the Philatelic Agency of the Post Office Department and last year the sales of stamped paper through this Agency amounted to $135,000 and the total sales at the Agency, since its establishment in 1921 to the present time, amount to approximately $350,000, which tends to prove how greatly it is appreciated by the philatelists throughout the country.

Mr. Glover also instituted a method of selling foreign money orders to the patrons of the Post Office Department which meant the saving of thousands of dollars to the patrons of our foreign Money Order System. The principal feature of this method was the permitting of rapid changes in the rate of exchange to all of the money order offices throughout the country, thereby giving the purchaser of the money order the advantage of the change in the rate of foreign exchange.

Mr. Glover married Miss Anna Bell Englis, daughter of John Englis a shipbuilder of Brooklyn, N. Y. He is a member of the National Republican Club; Knickerbocker (Englewood) Union League (Hackensack), Carteret (Trenton), Columbia (Wash.).

Royal Air Force has Engineering Problems

Credit Given to British Aircraft Industry for Engineering Progress

Both McCook Field and the Naval Aircraft Factory will find consolation in reading that the engineering departments of the R.A.F. have their critics too. The following article from the London Morning Post, *March 31 written by its "Aeronautical Correspondent" gives an insight into the engineering difficulties that the pilots of the R.A.F. encounter.—Ed.*

When the Air Ministry orders a new type machine, the Research Department produces a specification stating broadly what flying qualities the machine must possess, and calling for a certain "layout." When the first experimental machines have been built the Research Department tests them, and demands any modifications thought necessary. It is then decided whether or not the machine should be ordered in quantity for the R.A.F.

The R.A.F. fighting airplanes of today perform badly largely because the official specifications cripple the designer, and because the official tests are inadequate and the results sometimes misleading.

Take first the specification for a scout. It might call for a high degree of manœuver, speed, view for the pilot, load factor of seven all over (this fixes the strength of the machine), fuel capacity for 2.5 hr. flight and two guns. It might be indicated also that a wing-loading of over 10 lb. per sq. ft. would be looked upon with suspicion.

So far the designer can produce a machine to fulfill the official requirements. But observe what follows in the specification (which is typical of many): the machine must carry:

Electrically heated clothing with dynamo and attachments (15 lb. approximately).
Fire extinguisher (size about 1 ft. by 5 in.).
1 "R.L." bomb flare tube (3 ft. by 6 in.).
10 Flares for "R.L." tube (8 in. by 3 in.).
Signal Pistol.
20 cartridges for signal pistol.
Oxygen apparatus (container 2 ft. by 10 in. and about 15 lb. weight).
Self-starting magneto.
All the above placed to be easily accessible.
Landing lights and all night-flying equipment.
Guns to be accessible from *inside* the cock-pit.
All instruments and compass.
Ammunition box for empty rounds.

The designer who, at the best, has to effect a difficult compromise, now is so fettered that all hopes of producing a clean design, embodying a single broad conception, are dashed. The accessories may have increased the total weight of the airplane so that, in order to keep down the wing loading, the wing area must be augmented. Loss of speed and climb inevitably will result.

Like the White Knight

But the worst is not yet. While the first machine is being built Air Ministry experts inspect it and demand alterations. "these gun positions will not pass the new R.A.F. requirements. This must be cut away. That must be moved from here to there," and so on. By the time the machine goes to the test squadron it is loaded with odds and sods like the White Knight as a preparation for every emergency. "You see it's as well to be provided for *everything*. That's the reason the horse has anklets round his feet."

"But what are they for?" asked Alice.

"To guard against the bites of sharks," the Knight replied. No wonder that the Knight kept on falling off his horse, or that the performance of these airplanes is reduced.

And now let the methods of official performance test briefly be criticized. Testing airplanes is specialized work, which the average R.A.F. pilot is incapable of accomplishing without previous training. Yet the Air Ministry does not attempt to collect and to keep together a body of experienced test pilots. When an officer has learnt how to carry out test flights with a high degree of accuracy he is ordered to go abroad and his place is taken by an officer who is an expert at navigating airplanes over the desert, or at football. The result is that the tests are less comprehensive, less accurate, and take longer to complete than when Colonel Tizard originated the system several years ago. Sometimes faults in new types are not discovered. Sometimes the causes of faults are not traced.

The ineluctable conclusion drawn from a close review of the work of the Research Department is two-fold. The insistence upon airplane designers working to official specifications, and the present methods of conducting the R.A.F. airplane experimental establishment are both subversive to the production of the best fighting airplanes.

The Royal Air Force technical equipment is of poor quality, and the failure to produce better airplanes is due, in some measure, to the workings of the Research Department. It is here proposed to indicate a line of action which would lead to an improvement in the quality of our air equipment.

Where the Air Ministry concerns itself with technicalities there is either stagnation or retrogression. It has been shown already how the designer is hampered by official specifications and how experiments are entrusted to those who are not fitted to conduct them. Sir Frederick Sykes draws attention to these evils in the current issue of the *Empire Review*. "Research work as a whole at the Air Ministry," he writes, "requires reorganization in the interests of safety and progress."

Smartness

The Air Ministry fails when it dabbles in technicalities partly because engineers are in an infinitesimal minority in the Air Force, and partly because the higher command encourages officers and men to spend most of their time meditating upon and practising the science of forming fours and forming two-deep. The proficiency and personal smartness of R.A.F. troops on parade (on the ground) are the wonder of mankind, and, although the Army lacks its own Air Force, the Air Force emphatically does not lack its own Army.

But infantry drill and aeronautical progress are as the poles asunder. If there is to be aeronautical progress the spark of inspiration from which it springs must be cherished. Yet when the practical development of an idea is compelled to go through the "usual channels;" when the Air Ministry acts as the medium between inspiration and expression, between the thought and the thing, the spark is extinguished.

It is not always the fault of the officials themselves that new things and swift movement are looked upon with distaste; it is often the fault of the system. But so long as the system prevails, technical equipment will suffer neglect.

There are two methods by which the system may be made innocuous and the way be opened for an improvement in air equipment. The R.A.F. could include a technical department composed of engineers and skilled pilots; or expenditure on the R.A.F. could be reduced drastically and the money be applied to the support and the encouragement of aircraft constructors in their search for improvements in design. Probably the best course lies midway between these two.

Undoubtedly the personnel of the R.A.F. generally and of the Research Department particularly should endeavor to reach a much higher technical standard; but with an improvement in R.A.F. technical proficiency a saving in expenditure could be effected. For example, if the establishments at Farnborough, at Martlesham Heath and at Felixstowe were manned with specialists they could do more useful work than they are doing at present with half the strength in personnel.

If the aim of the R.A.F. were directed solely at attaining the maximum possible air strength, retrenchment could be effected in many other directions, and a fund would become available for rewarding those responsible for practical achievements in aeronautics. Now, every noteworthy step in aeronautics has been made by private firms, and it is to these firms that the future aeronautical development should be entrusted. In France—which now leads the world in the air—800,000 francs are offered in prizes this year to constructors who produce record-breaking machines, and these prizes will be awarded *even if the airplane is provided by the State itself*. Here, then, is one way to encourage progress by private enterprise. Another way was suggested by Sir. H. Brittain in the house of Commons recently, when he asked for the guarantee of a measure of continuity in constructors' contracts, in order to avoid the disorganization and waste caused by orders given in fits and starts.

The expansion of the R.A.F. requires very careful direction. The R.A.F. must grow, but it must grow homogeneously as it were; its technical knowledge and the performances of its machines must advance with its numbers. It must no longer be inflated like a penny balloon, which looks pretty, but which contains wind—nothing but wind.

An improvement in technical training, heavy restriction on the meddling powers of the Research Department, and large financial aids and rewards for practical advances made by constructors are the means ready at hand for improving our air equipment. All subsidiary needs should be subordinated until the main essential—the production of British airplanes of as good quality as any others—is achieved.

Air Movie Staging Demonstrations

The producers of the latest moving picture featuring aircraft, the "Sky Raider," have adopted a novel means of advertising it. This picture features Capt. Charles Nungesser, the famous French ace. They have arranged to have Captain Nungesser and his star pupil Weiss make personal appearances in the cities where the picture is being shown. They also stage a sham battle over the city. Weiss represents the attacker and Captain Nungesser the defender. After some combat, Weiss simulates being shot down, and the hero of the picture remains victorious over the city. This stunt not only creates interest in the picture but also serves as an additional boost for aviation as the newspapers are supplied with instructive matter to accompany the story.

N.Y.E.S. Aeronautical Meeting

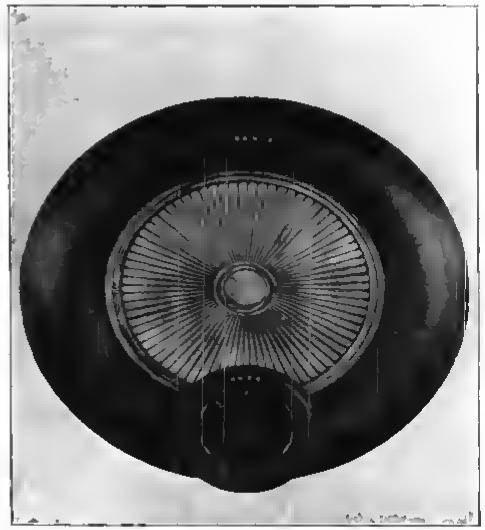
The New York Electrical Society held a meeting in New York City on May 21 which was entirely devoted to aeronautics. The speakers were Capt. Harold M. McClelland, A.S., and Grover Loening, the well known airplane designer and manufacturer.

Captain McClelland was the first speaker and took as his subject, "Accessories of Aircraft." As might be expected, his emphasis was on those accessories and instruments which are mainly electrical in design. The first item he took up was the earth inductor compass. He had a demonstration setup of the new Pioneer electrically driven compass which he used in explaining the theory and operation of this improvement over the needle type of compass. He then took up the landing lights in use by the Army Air Service and the Air Mail. The SCR134 radio set was then taken up and its component parts explained. Captain McClelland concluded his address with a demonstration of radio communication between airplanes and the ground. A Martin bomber was flying over the hall, equipped with one of the SCR134 sets. A landline was laid to the radio shack at Mitchel Field and communication was carried on between Captain McClelland and Sergeant Moselander in the plane. A loud speaker was used to enable the audience to hear the description of the flight sent from the plane.

Mr. Loening took as his subject, "How Aircraft Engineers are Developing Safety and Utility." He said that, in his opinion, the important features of aircraft from the standpoint of commercial use, are reliability, cost and safety, in the order named. He pointed out that it would be difficult to attract traffic if a service was safe and inexpensive but unreliable, whereas a good volume would be forthcoming if the service were reliable and inexpensive, without any particular emphasis being placed on safety. He showed several reels of very interesting moving pictures. They covered Air Mail flying, Army bombing plane flying, Navy ship plane flying and the crash tests. The engineers at Dayton have learned a great deal about the causes of fires when an airplane crashes, from these tests, according to Mr. Loening. It was shown, by these movies, that very long exhaust pipes caused the wreckage to take fire while otherwise identical planes, crashed under the same conditions, but with stub manifolds, did not take fire.

A Contrast in Airplane Wheels

The accompanying illustration furnishes a striking contrast between two airplane wheels produced by the Dayton Wire Wheel Corp. of Dayton during the past six years. The small wheel (20 x 14 in.), built in 1918, was built for training planes, while the large wheel was constructed last year in cooperation with the A. S. Engineering Division at McCook Field for a new heavy bombardment plane. The wheel is equipped with 64 x 14 in. Silvertown Cord tire and weighs 395 lb. The test load withstood by this wheel was 60,000 lb.



New Small Engine Developed

A new design small aircooled engine for use in small airplanes for shipboard use has been developed by the Navy and has lately passed its block tests. This engine develops 60 hp. at 1800 r.p.m. and weighs only 208 lb., or 2.6 lb. per hp. This engine has been built and tested under Navy Department specifications, by the Kinney Manufacturing Co., Boston, Mass. In order to obtain a small engine of such light weight, it was necessary to introduce a number of novel features of construction. The engine is a static-radial having five cylinders. The usual push rod construction for actuating the valves has been eliminated and in its place has been substituted a hydraulic valve gear utilizing the lubricating oil.

The first engine has recently passed all its tests and is being shipped to the Naval Aircraft Factory for further test running. Four additional engines will be completed at an early date and will be immediately installed in small aircraft for their further flight development. The Navy's program of small airplanes for shipboard use hinges about this engine and its development marks a new and important step in the Navy's plan for employing airplanes on board all surface craft.

AIRPORTS AND AIRWAYS

Cleveland, Ohio

By Cy Caldwell

Carl B Fritsche of Detroit, secretary of the National Air Transport Co, here to meet Cleveland business men, said the company will utilize the new Cleveland Airport as operating headquarters of the main route, provided the backers are promised a reasonable business of high class freight which the line would carry A Detroit connection, Mr Fritsche explained, would be made by a plane leaving Cleveland at dawn and arriving in Detroit in time to make early morning deliveries Mr Fritsche is also president of the Aircraft Development Corporation of Detroit

Arch F Alspach, pilot for the Woodson Engineering Co, Bryan, Ohio, recently visited Glenn L. Martin Field with his company's new plane, a Salmson engined two place ship O L. Woodson is to be congratulated on constructing a very useful plane with apparently good flying qualities

Eddie Stinson of Detroit made a flight to Cleveland with Dr Miller, the psychologist, and party While here Dr Miller broadcast a lecture from Stinson's Junker by a new broadcasting machine designed especially for airplane work by experimental radio station 8XAB

Word came over the wire from Toledo, Ohio, that a rattlesnake had so far forgotten himself as to sting a young lady, or bite her, or something Anyhow, she was a bit put out by the incident and wired for serum to be brought from Cleveland by plane I've drank rattlesnake serum myself for years, even when I hadn't been bitten, but just in case I should be. So naturally I was selected to fly the serum to Nome—I mean Toledo Well, I got the engine warmed up and had a shot or two of serum and was just taking off when word came that the lady had recovered and someone had slapped the snake on the wrist, so I didn't have to go I drank the rest of the serum myself in case the snake should come to Cleveland and bite me

The City of Cleveland has purchased 1000 acres of land for a Municipal Flying Field It lies or lays (according to whether you went through or merely past Harvard—I went right by, myself) it lays 10 mi southwest of Cleveland Public Square, the center of American civilization, on the main road to a disconsolate dot on the map called Berea The field is some 2 mi due north of this Main Street hamlet and just west of the New York Central and Big Four tracks To the west of the field Rocky River is joined by a small brook. Any pilot who can't find the field from this description should stick to a Ford and roads—and not forget his earmuffs and rubbers when he goes out. This will be the most important flying field in the world, according to real estate men selling lots in its vicinity And if you can't believe a real estate salesman who in time can you believe?

A spur track connects the field with the New York Central at Berea Interurban cars and a bus line dash madly by the field every 20 min, arriving at Cleveland Public Square 30 min later or even later City water, light, and power are available on the property, natural gas underlies the field and may be piped for heating plants However, with a number of pilots around, this natural gas is a useless extra

J E Whitbeck, superintendent Eastern Division, U S Air Mail, when interviewed at lunch in the Waldorf Castoria, said: "The Air Mail has acquired space on the field on which are being erected three hangars 85 ft square to accommodate four ships each, which makes twelve ships in all, Cy, in case you can't multiply that high These are steel frame permanent hangars, with concrete walls and floors, and wooden roofs covered with Barrett Specification Roofing (Advt) Hangars are grouped around a 75 ft by 150 ft concrete court There will be a Division Office building of brick to conform to the dainty architecture of the hangars, a fireproof store house of concrete, a fireproof gas and oil storage, and a concrete transformation house.

"These buildings set back—or sit back, which is it, Cy?—anyhow, they're 300 ft. from the road, separated from it by a lawn and shrubbery; without the usual Air Mail decoration, a pile of old Liberty boxes. Two 3,000 ft, runways are being prepared and with the buildings will be ready for use July 1.

"The biggest light in the world, the B B T imported from France—now don't write that B V D, Cy—will illuminate the field for night flying It is half a billion candle power diffused through a 180 deg Fresnal lens—which cost $4,500 for the lens alone Thus lens spreads over the field a grayish green light so penetrating that you could read a newspaper a mile away You understand, Cy, you and the newspaper are together, a mile from the lens. The light is soft and well diffused and illuminates only the ground and 30 ft. above. There is no glare and planes may land toward the lens as easily as away from it. The light is operated by a 220 volt three phase generator and 25 K W generating set. There are four of these lights in the country—at Omaha, Bellefonte, Cleveland and New York."

Boston, Mass.

By Porter Adams

The next few weeks promise to be busy ones from the standpoint of aviation in this vicinity Already both the Army and the Navy are making almost daily exhibition flights for the American Legion Endowment Fund drive and on June 17 much aeronautical interest will be aroused by the departure from Boston of the MacMillan Polar Expedition with the accompanying Naval planes under the command of Lieut. Comdr Richard E. Byrd, Jr, U S N Mayor Curley is giving an official luncheon to MacMillan, Byrd and their associates on June 15, and the Boston City Club one the following day As June 15 is also the date of the Chamber of Commerce luncheon to Col Paul Henderson, aeronautical enthusiasts are in a quandry to know which luncheon to attend

Coincident with the departure of the Naval Polar Flight on June 17, the *Boston Evening American* has announced a prize air flight with awards totaling five hundred dollars. This contest will be open to the officers and men of Massachusetts National Guard and much interest has already been aroused therein

It has been announced that the Navy will send several planes to Poland Springs in connection with the Governor's conference and that the Shenandoah will also make a flight to Maine during this time

On Sunday, June 7, the Boston-Traveller-Westinghouse station WBZ of Boston and Springfield will broadcast a special program for the benefit of the American entries in the International Balloon Race at Brussels, Belgium Already messages of good will have been received from Godfrey L. Cabot, president of the N A A and from the U.S.S. Shenandoah for transmission to the pilots

Dan Rockford, the hustling and genial aviation editor of the *Boston Transcript* who is doing so much for aeronautics hereabouts, had his first loops and spin the other day over the Boston Airport and he concludes an excellent description of his impressions with the following "There's nothing in the world like flying. No man ought to die without trying it. It's safer than any other human method of realizing thrills. Millions of people drink stuff every day that is more dangerous than three loops and a tail spin. And all the million drinks together haven't the kick that the loops and spin have."

Two flying schools have announced operations in the press during the past week. Edward T O'Toole who has been at the Airport practically since it was opened, advertises for pupils at the Airport and the Aiglon School of Flying announces that Mark C. Hogue, former instructor for the Army will instruct either at the Airport or at the company's field at Weston, Mass.

Dallas, Tex.

The Southern Airways of Love Field report an exceptionally fine flight made by one of their pilots from Texas to Wisconsin and return Mr. and Mrs. Protheroe of Dallas were the passengers and the flight was made as that Mr. Protheroe could reach Wild Rose, Wis., in time for his mother's funeral Although the plane had over for two nights it still made better time than could have been made by using the train. The machine used was an OX5 Standard J1 and the pilot was R H Gray, a New Zealander, formerly of the R.A.F. but now pilot for the Southern Airways. Leaving Dallas at two o'clock in the afternoon the first night was spent at Locust Grove, Okla., the second night at Anamosa, Iowa and Wild Rose was reached on the morning of the third day The total flying time was 14 hr. 50 min for the 960 mi covered. The country flown over was unknown to Gray and as he had no compass he had to find his way from his Rand McNally map The return trip was made in 17 hr 35 min with a stop off at Kansas City, Mo

Cincinnati, Ohio

By Ralph Love

A radio program broadcast from the air was enjoyed Monday night, May 18, by radio enthusiasts in Cincinnati and nearby cities Capt Frank H Pritchard, in charge of the radio laboratories at McCook Field, Dayton, and temporary commander of the Grisard Field, Cincinnati, piloted the radio plane Capt W. H Murphy, of the signal corps, conducted the program in the air Flying at an altitude of 500 ft., Murphy delivered a talk on the Citizens military training camps to be held at Camp Knox, Ky, and Ft Benjamin, Ind The radio plane was an all-metal machine, with Liberty XII engine and capable of 115 mi/hr

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Three ships were delivered last week by the Watson Airport Co The Great Lakes Airways Co, Erie, bought a Jenny from the Watson Co., while George Hammel, Erie, purchased a ship of similar type. Fred Schenke of the Avondale Motor Co., Cincinnati, bought a plane to be flown by George Waddkind commercially from the Hamilton, Ohio flying field

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Lieuts. Wright Vermilya and Miller Outcalt led an air attack of Army planes Sunday, May 17, on the 147th infantry base at Camp Ross. The infantry staged a sham battle on the ground, and conducted a sham fight against the airplanes, which dropped a number of bombs

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E. S Gahagen, Cincinnati Studebaker dealer, purchased a ship last week from the Pavey Flying Co to be used for advertising purposes Wendell Pavey, in charge of the Pavey Field, is instructing one of the Gahagen employes in flying, and the latter will fly the ship carrying Studebaker ads later in the summer

Minneapolis, Minn.

By Art Pierce

H S Rounds will leave with an OXX6 motored Standard for Assiniboia, Saskatchewan, about the 15th Rounds is with the C. P Railroad, who plan to give their surveyors such assistance as the plane can render although actual aerial surveys are not contemplated

W. C Williams and Sylvester Whitman are taking an OXX6 engined Standard just purchased to Fond Du Lac, Wis. soon.

Joe Westover has delivered ships for Marvin A Northrup this spring to Ashland and Williams, Wis., also one to an Illinois town Several students have enrolled with them recently

Eddie Midaughs is having a Thomas Morse Scout rebuilt for an OX5 engine and passenger cockpit

A Thomas-Morse Scout made a spectacular landing in a front yard of the residential district recently. The propeller, fuselage, tail surfaces and pilot were uninjured The wings, however, were slightly scratched in the manner common to trees and telephone poles The pilot was attempting to stretch a glide and reach a nearby swamp when a benevolant tree, probably alarmed at the precarious nature of the glide caused him to do an about face. A premature landing thus became necessary.

The Gypsies are finding that "in union there is strength" and also passengers. Charles Holman with Blackstone as wingwalker is clubbing with Swenson's auto polo and motorcycle outfit. They have put on a couple of shows and have others advertised. D. L. Snyder is organizing a circus of three planes, his own Jennies and Walter Hallgren's Standard. He will operate with auto polo games and motorcycle races in connection with his show Babcock will do the parachute work and wing walking C W Hinch's auto polo and racing team started May 17 at Hutchinson, Minn. He will have three planes with him Thro with a Thomas Morse, Peirce with a Jenny and Berg with his Hisso-Standard. Hennessy will be the acrobatic and parachute man Hinch has a full summer's work booked in Wisconsin

Walter Bullock has designed an antidote for hotel bills, an up-to-date covered wagon It has a stove, running water, folding bed and a host of modern appliances. It is rumored that he will have a back porch constructed before he starts barnstorming Despite the splendor of this outfit if one dodges the balloon tires and makes a careful search, there will be found near the front end the old familiar Ford engine

Perhaps this will convince the air-minded that not all of the Northwest is anchored to the ground It will be only a short time till the children here will fly as easily as they ride a bicycle, in fact the doctor's are anxiously watching for signs of wings on the new born babies.

Pittsburgh, Pa.

By Ray A Tucker

Cleveland has its Cy Caldwell and Boston its Porter Adams but Pittsburgh has its Clyde Kelly, the proud father of that new and promising infant, the Kelly Air Mail Contract Bill His work in Congress was untiring during the four years which were necessary to have it become a law Through Congressman Kelly's efforts, Pittsburgh has thus contributed much toward stimulating commercial aeronautics throughout the nation The Aero Club of Pittsburgh recently entertained Mr. Kelly at luncheon and in his address he closed with this statement—"By this Air Mail law, we can develop aviation and at the same time confer a valuable service to American business by expediting mail at a charge which is just to the interests served and at the same time profitable to the aircraft companies It will help make America first in the air"

Lieut. Jack Harding and Lowell Thomas afforded the natives a treat last month by giving their illustrated lecture on the World Flight While here, they were entertained at a special luncheon given by the Aero Club

Rodgers Field, the 40 acre Pittsburgh Municipal Airdrome, is rapidly nearing completion, as grading operations are practically finished

A recent inventory develops the fact that fourteen members of the Aero Club individually own seventeen ships and most of these will be flying from Rodgers Field this summer Really though, correctly speaking the number of ships should be placed at sixteen and one-half, as Frank Ambrose lost half of his Thomas-Morse two weeks ago in a crash in Wheeling, W. Va., because of engine trouble, developing while over the city His ship lifted a chimney from its moorings and Ambrose, ship and chimney landed in a back yard, just managing to embrace a step-ladder, from which the owner leaped just before the crash Ambrose, luckily came out of it all without a scratch and will swear on the Koran that this is no fairy tale

The Aero Club has leased as a Clubhouse, a house adjoining Rodgers Field situated within 200 ft of the two government hangars Improvements involving considerable expenditure will be made upon the house and grounds It is hoped that in the near future the Club will be in a position to extend its hospitality to visiting pilots.

The 324th Observation Squadron of the 99th Reserve Division, located at Pittsburgh, held a get-together dinner last month at the Fort Pitt Hotel to meet the new C O, Maj. J B McCalley Plans were outlined for summer training, using the Government ships which will be available for reserve use at Rodgers Field

Things are booming in Pittsburgh

UNITED STATES AIR FORCES

U. S. ARMY AIR SERVICE

Aerial Photos Aid F. A.

An important aerial photographic activity is going on at Pope Field, Fort Bragg, N. C. The Field Artillery Board are trying to reduce the use of aerial photographs for computing firing data to such a practical basis that it may be incorporated in the Field Artillery Training Regulations.

The aerial photographic end of this investigation is being handled by Lieut. Edmund C. Lynch, A.S., and three enlisted men from Langley Field. Maj. Faulkner Heard is the member of the Field Artillery Board who is handling the actual use of the photographs in firing problems.

The photographs are taken by Lieutenant Lynch, prints made, and data as to the scale and orientation inked on the print before it is tacked over to the board. Major Heard computes the firing data and fires a problem to see what accuracy could be obtained. Several problems were fired in order to strike an average.

The investigation started with the use of a single photograph which showed two panels, one representing a reference point, visible from the observation post on the ground, the other representing a target, assumed invisible from the observation post. These panels had been accurately located by surveying methods so that the accuracy of the photographs could be checked. The scale was determined by taking photographs of a base line, assumed to lie behind our front lines, before flying out over the range to photograph the panels. Orientation was a more difficult problem, as the panels were assumed to be in unknown territory. The most accurate means of orientating was by means of the "Baldwin Solar Chart," which gives the angle between the line of shadow and true north when the time, date, latitude and longitude are known. In firing the problem the gun was adjusted on the reference point by ground methods and then shifted to the target by means of the data obtained from the photograph. Only one gun was used, but the group of shots fell so close to the target that it would have been destroyed had an entire battery been used.

These tests were conducted with 75's, and 155 mm. howitzers. In the first test with the smaller guns the results were so good that it was thought perhaps some element of luck had entered into the result, but when the test was repeated at a longer range with the howitzers and the same excellent result was again obtained there could be little doubt as to the value of the method. It will be possible to use this method in connection with several others. One of these was tried in connection with the tests in which the airplane used the "Lay on me" method of locating a registration point, and then after a few adjusting shots on this point fire was shifted to the target.

The second step in the investigation was the use of a mosaic strip and a mosaic. They were assembled very accurately. No attention was paid to matching the topography, the photographs being assembled using their centers and ground control. However, no ground control was used beyond a line assumed as the battle front. The presence of a large number of control points made it easy to tie the mosaic together. It also made a strong foundation for the grid which was placed on the mosaic and strip. The mosaic, since it was gridded, was used like a map in computing the firing data. That is, the range and deflection was not only scaled off, but they were also computed from the coordinates, as scaled from the mosaic.

At present the Tri-lens camera is being used to work out a series of problems of a more complicated nature. There has only been one problem fired from these photographs as yet. The results so far have shown that the Field Artillery are no longer helpless when the target is invisible and no maps are available. The Air Service takes on a new relation with an arm that now uses aerial observation as a matter of course.

Another important experiment which can be used in this connection was a time test as to how quickly a gridded photograph of a designated position could be delivered to a battery for use in regulating fire on a certain point. With no special apparatus with which to speed up the process, photographs were dropped at the battery in about 1 hr. 40 min. after the request had been received at the Field. This result was considered very satisfactory to the members of the Field Artillery Board conducting the tests, and it is figured that this time can easily be reduced to about one hour by the use of apparatus for developing the film while the plane is returning to the field. These tests were made with photographs taken at 12,000 ft. Complete reports on the various tests which have been conducted will be made soon by the Field Artillery Board, and it is believed they will result in considerable advancement in the use of aerial photography for regulating artillery fire.

Bombardment Conference

Six officers and six enlisted men from Langley Field recently spent a week at Kelly Field, Tex., after a cross-country trip in three Martin Bombers. The officers were Maj. John H. Pirie, Captains Hale and Duncan, and Lieutenants Graham, Davies and Whiteley. The purpose of this flight was to bring about an interchange of ideas between the officers of the 2nd Bombardment Group and the Bombardment Department of the Advanced Flying School. During their stay at Kelly Field daily conferences were held and important matters of mutual interest pertaining to Bombardment Aviation were discussed. At the conclusion of their visit it was felt by all concerned that a great deal of benefit was derived from this conference. It is believed that similar discussions would be of great value throughout the Air Service.

Richards Field

With the coming of warmer weather, activities of the U. S. Army Air Service Reserves have taken a decided upward turn. During the past month local pilots have flown 139:30 man hours as compared to 69:45 hr. the month preceding. Fifteen pilots and 25 observers participated in flights numbering 152 pilots and 135 for observers. A number of cross-country flights were made from Richards Field, in which the local Reserve Officers took part. Stations visited during the past month were Marshall Field, Ft. Riley, Kans.; Ft. Leavenworth, Kan.; Ft. Crook, Neb.; St. Louis, Mo., and St. Joseph, Mo. The outstanding flight was the one made to St. Joseph on April 30, for the purpose of attending the National Balloon Races there on May 1, 1925. Maj. Gen. Mason M. Patrick, U. S. Army, Chief of Air Service, issued authority that this flight be made by local Reserve Officers, which authority was greeted whole heartedly by all.

First Lieut. Isaiah Davies, A.S., the commanding officer of Richards Field, accompanied by Capt. F. C. Venn, M.C., U.S.A., the Seventh Corps Area Flight Surgeon, stationed at Richards Field, led the flight with his DeHavilland. The following named Reserve Officers participated, flying a JN formation: Capt. William L. Campbell, A.S. Res., flight captain, pilot with mechanic; Capt. Charles B. Stead, A.S. Res., pilot with mechanic; 1st Lieut. Louis E. Steinhauer, A.S. Res., pilot; 1st Lieut. George T. Long, A.S. Res., observer; 1st Lieut. William S. Green, A.S. Res., pilot; 1st Lieut. William P. Foed, A.S. Res., observer; 2nd Lieut. Wilfred O. Moore, A.S. Res., pilot; Tech. Sgt. J. Ralph Walker, A.S.E.R.C., observer; 2d Lieut. James K. Walker, A.S. Res., pilot; Lieutenant Stevenson, A.S. Naval Reserve, observer.

The Squadron was most enthusiastically received by officials from the St. Joseph Chapter National Aeronautic Association and entertained most royally.

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On May 4 General Patrick paid a visit to Kansas City, accompanied by 1st Lieut. St. Clair Street, A.S., U.S.A., his personal pilot. He was received at Richards Field by Capt. F. C. Venn, M.C., and 1st Lieut. Isaiah Davies, A.S., commanding officer. In addition a reception committee had been designated by the Chamber of Commerce, which immediately took General Patrick on an inspection tour of the newly proposed landing field in the Fairfax Industrial District of Kansas City, Kan. An informal dinner was given the General in the Chamber of Commerce of that city. On May 5 General Patrick departed for Muskogee, Okla., continuing on his inspection trip of all Air Service stations.

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Although no new officers have been obtained for the Air Service Officers Reserve Corps during the past month, five men joined the Enlisted Reserve Corps, bringing that total up to 15. The Air Service Officers Reserve Corps of Greater Kansas City consists of 1 lieutenant colonel, 5 majors, 8 captains, 20 first lieutenants and 63 second lieutenants, a total of 97. 3 chaplains and 8 medical officers are attached to Headquarters 8th Attack Wing 6th Army, Air Service, (Reserve) with offices at 20th & Vine Sts., Kansas City, Mo.

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At the present time all arrangements are being made to entertain approximately 115 Air Service Reserve Officers at Richards Field during the Summer Training Camps, beginning July 5 and terminating on Aug. 30. A large amount of the various supplies needed are being received constantly from Supply Depots to carry on the training schedules during these camps. All ships have been completely overhauled and are now awaiting the arrival of the fliers for the training camps. Although there are now only eight Jennies at the field, four additional planes of this type are expected to bring their number up to twelve. The roads leading to the field will be graded and oiled; grass on the field will be mowed, hangars are now receiving a new coat of paint and everything is being placed in tip-top shape. We are looking for a very busy season and hope is expressed that the coming camps will be even more successful than the camps of 1923 and 1924.

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Transient aircraft always play an important part here. Richards Field has been designated an Airway Station on the route Kelly Field to St. Louis. Planes arrive on schedule from Muskogee on Tuesdays, leaving for St. Louis on the same date, returning to Muskogee enroute to Kelly on the following day. Ships landing here between May 1 and May 25 numbered 38 DH's, 3 Martin Bombers, 9 Jennies, 2 TPI's and 1 TW3, a total of 53. We have had as many as 75 to 80 during preceding months. Transient ships which were refueled here were from Marshall Field, Ft. Riley, Kan.; Post Field, Ft. Sill, Okla.; Scott Field, Belleville, Ill.; Chanute Field, Rantoul, Ill.; Anglum Field, St. Louis, Mo.; Bolling Field, Washington, D. C.; Langley Field, Hampton, Va.; McCook Field, Dayton, Ohio, and Brooks and Kelly Field, San Antonio, Tex.

Army Air Orders

Following officers A.S. relieved from assignment indicated and will proceed to McCook Field: Capt. Junius H. Houghton, San Diego, First Lt. George V. McPike, Fairfield.

Staff Sgt. John A. Fitzpatrick, A.S., Mitchel Field, retired.

Capt. Laurence F. Stone, A.S., McCook Field to Fairfield.

Sec. Lt. Harold E. Smyser, A.S. (Inf.), Brooks Field, to Fort Sam Houston.

Maj. Albert L. Sneed, A.S., Fort Leavenworth, to Kelly Field.

Maj. Harrison H. C. Richards, A.S., Langley Field, to Maxwell Field.

Sec. Lt. Richard G. Herbine, A.S., Kelly Field, to Brooks Field.

First Lt. Ployer P. Hill, A.S., Chanute Field, to Mitchel Field.

First Lt. Leslie P. Arnold, A.S., Bolling Field, to New York City, sailing Sept. 22 for San Francisco, from which point he is to proceed to San Diego.

Following officers A.S. Tech. Sch., Chanute Field, to report to commanding officer that station for duty: First Lt. Charles Backes, Sec. Lts. John W. Warren, James M. Fitzmaurice, Herbert K. Bassley.

Orders No. 4 assigning First Lt. Joseph A. Wilson, A.S., to McCook Field amended to assign Lieutenant Wilson to Mitchel Field.

Capt. Henry C. White, A.S., Little Rock, to Chanute Field.

Capt. Thomas Boland, A.S., Langley Field, to temporary duty at Fort Riley. Upon completion of this duty Captain Boland will proceed to Mitchel Field for temporary duty in connection with summer training camps, upon closing of camp returning to Fort Riley.

Maj. Ire Longanecker, A.S., Fort Leavenworth, to Boston.

Following officers A.S. relieved from assignment at A.S. Tech. Sch., Chanute Field, and will proceed to stations indicated: Sec. Lts. Joseph H. Hicks, Marshall Field, Stewart W. Towle, jr., Scott Field, Thomas M. Lowe, Langley Field, John M. Weikert, Kelly Field.

Sec. Lt. William E. Baker, Inf., Plattsburg Barracks, det. to A.S., Brooks Field.

Capt. P. Mortimer, A.S., Brooks Field, to Fort Sam Houston.

U. S. NAVAL AVIATION

Airship Schedule

The following operating schedule for the Los Angeles and Shenandoah has been approved:

Los Angeles—May 20-June 10: Passenger flights Annapolis; June 1, 2, 3; Minneapolis, June 8; June 10-June 20: Deflate, begin overhaul; June 20-Aug. 1: Overhaul and prepare for flight to Hawaii.

Shenandoah—May 20-June 10: Preparation for flight according to helium available.

June 10-June 20: Finish inflation using helium from Los Angeles.

June 20-Aug. 1: Operations with fleet. If practicable make flight up Hudson to Poughkeepsie on afternoon June 22 during inter-collegiate boat race; Flight to Portland, Me., July 4 connection Governors' Convention.

Naval Air Orders

Lt. Ralph L. Lovejoy det. 7th Nav. Dist., Key West, to Nav. Air Sta., Pensacola.

Ens. Thayer T. Tucker det. U.S.S. Kane to Nav. A. Sta., Pensacola.

Lt. Comdr. William J. Hine det. U.S.S. Pittsburgh to Nav. Aircraft Fact., Phila.

Lt. Harold B. Sallada det. U.S.S. Richmond to U.S.S. Raleigh. Orders March 30, to Nav. A. Sta., Coco Solo, revoked.

Lt. (jg) Walter F. Boone to continue duty U.S.S. Burns. Orders Apr. 11, to Nav. A. Sta., Pensacola, revoked.

Ens. William T. Rassieur det. U.S.S. Idaho, to Nav. A. Sta., Pensacola.

Comdr. Donald W. Nesbit det. aide on staff, Comdr. Train. Sqd. 1, Ft. Base Force, to Nav. A. Sta., Pensacola.

Lt. Comdr. Samuel R. White det. Nav. Air Sta., Pensacola, to Bu. S. & A.

Lt. George R. Brooks det. Eng. Sch., Fort Humphreys to Nav. A. Sta., Pensacola.

Lt. (jg) John P. Womble det. U.S.S. Somers to Nav. A. Sta., Pensacola.

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Publisher's News Letter

The success of the German cross country race will give rise to much discussion as to whether or not this is not the ultimate form that all air races will take. The race occupied several days and covered several cross country courses so that a large number of different cities could participate in the affair. If a similar race could be held with Chicago as the hub a very interesting plan could be worked out. One lap could be flown to the Twin Cities and back, another could be to Detroit and Cleveland with a return flight over Dayton, Cincinnati and Indianapolis. A third might go to St. Louis and Kansas City with a return route via Davenport. The mere suggestion of the routes that could be included brings out the great advantages of this kind of an aerial contest. The day of the enclosed air meet is fast drawing to a close. That was a good way of testing aircraft back in 1911 but with the increase in reliability of airplanes, the need for large courses becomes of increasing importance. Races held in congested localities so as to attract crowds have not been as great factors as they should have been in developing reliable aircraft. Detroit is planning a circuit flight this year and this may prove to be the start of a new series of cross country races that will interest whole sections rather than single cities. If the N.A.A. would schedule several such meets for different sections of the country, there would probably be greater interest shown in holding meets by localities that do not feel like having to finance the present form of air races to the extent of several hundred thousand dollars.

* * * *

Hidden away in an obscure part of the newspaper was an important item of news that probably escaped many readers. It announced that Italy had united its Army, Navy and Air Service under a single head. This plan which has been in the process of making for the last year is one that will be watched by other countries with the greatest interest. In Great Britain, there has been much discussion of a similar move, for several years, but the intrenched military and naval services have opposed it so strongly that progress has only been made to the extent of having an Imperial Council of Defense. At one time, it was thought that President Harding was to make an effort toward a unification of the land, sea and air forces of the United States but nothing was ever made public regarding the plan. The virtual dictatorship of Musolini has made such a change possible in Italy. While it was objected to by the older officers, it had the support of those who wished to eliminate duplications and avoid decentralization of command, one of the greatest difficulties that had to be overcome in the last War.

* * * *

That the experiment Italy is making will be watched closely by the United States goes without saying. It has all the merit of using modern business principles and as a measure of economy it will make a strong appeal. In time of war there has usually been one branch of the national defense that has been the most active. Either the war has been land or naval, or one of these two forms of warfare has been of the greatest importance. In the future, the air will have to be taken into consideration. It is entirely possible that the air may play a controlling role. This possibility has been questioned by very high authorities, but only time will tell whether they have been short sighted or not. As wars are more and more becoming a matter of materiel, the great need for a supreme director of supply is causing the unification of all defense agencies to be given greater attention. When those who believe in some form of an independent air force are asked for their views on this question, the reply is generally in support of some such arrangement. How the Italian Air Force will fare under the new unified department will be watched by all airmen, with the greatest interest.

* * * *

Too great credit cannot be given to our neighboring Air Force over the border. It has been announced that last year the fliers of the Canadian Air Force flew 3340 hr. without a fatal accident. As most of this flying was done in connection with carrying mail, patrolling forests and fisheries, and map making, the record is doubly interesting. So little is heard of the activities of our northern air friends that it is sometimes overlooked that Canada has an independent air force that operates practically independently of the Royal Air Force. While most of its equipment is secured from English manufactures, there is a possibility that Canada may become a market for specialized planes built in this country. In fact, last year some American planes were sold there for special uses. Every American flier will wish that the record that was made last year will be repeated this year. L.D.G.

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